

Activity Theory as a Design Framework for Collaborative Learning using Google Applications Technology

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Abstract. Collaborative learning involves small groups of students working together to solve problems for the purpose of learning. A large number of studies have focused on the technical aspects of computer-mediated environments for collaborative learning. This research distinguishes from other studies by employing a social learning approach. In this research, activity theory was used as a design framework for collaborative learning in a Web 2.0 environment using Google Applications technology. By employing an activity-oriented design method, a collaborative platform was developed to facilitate social learning activities that are mediated by artifacts and collaborative tools using the Google Applications environment.

Keywords: Activity Theory, Collaborative Learning, Google Applications

1 Introduction

Despite the growing interest in Web 2.0 applications and Internet-based collaborative learning technologies, research investigating the relationship of these aspects to design frameworks for collaborative learning has been limited. Web 2.0 can be described as an “architecture of participation”, which facilitates ease of usage, gives immediate feedback on the user interface and structural levels, and values each user’s contribution. Recently, we have experienced a significant increase in the number of users who voluntarily engage in Web 2.0 activities. Examples of activities relating to Web 2.0 applications include blogs, wikis, tagging, RSS feeds, file and media sharing, social networking, and online messaging. These technologies are often associated with social communication as well as rich user experiences and opportunities for playfulness.

The widespread proliferations of online collaboration tools allow communities of common interest to share content and commentary via online participation with wikis, discussion forums, and through various file formats that can be shared or edited online. As of 2010, the collaboration tools of Facebook have attracted 450 million

users. Social networking sites such as Facebook has increasing influence over university students with usage rate of over 90% per year at most campuses [6]. Educational institutes are starting to prepare students to collaborate in a world in which various tasks can be accomplished with an abundance of available collaborative tools through the Internet. Researchers in the areas of e-learning in Web 2.0 environments emphasize the importance of learner-centered approaches while considering the use of self-publishing, peer driven online leaning, and social networking. This suggests a greater focus on student-generated content, students' use of collaboration tools such as Web 2.0 applications, and modular tutoring. These innovative disruptions [2] are prompted by the development of Web 2.0 technologies that force us to think in new ways in preparation for the new challenges brought about by these changes.

Collaborative learning technologies refer to a set of tools for task-specific collaborations, and are associated with goal and work-oriented activities. Collaborative technologies such as Google Applications - the so-called "Applications of the Web" - have triggered a new wave of free online wikis, word processing, spreadsheets, presentations and discussion forum software since they were introduced in 2005 [10]. They bring a level of functionality originally associated with desktop applications to a Web browser, introducing ubiquitous possibilities for content creation, editing, and sharing.

2 Background of the Study

Collaborative environments in education involve small groups of students working together to solve problems for the purpose of learning. Google Applications consist of a set of tools developed by Google to facilitate collaboration. They incorporate features found in traditional office applications, as well as providing a common, shared space for collaborative work. There are three main applications provided by Google that facilitate collaboration: Google Docs, Google Forms, and Google Sites. Google Docs technology is a common platform for sharing documents in Google accounts. Google Forms facilitate a kind of spreadsheet document that can be used for developing online forms and surveys. Google Sites technology provides a tool for developing Web sites for collaborative work, handling documents, managing updates and wikis, and hosting forums for discussions.

The Google Applications platform was introduced at the Hong Kong Polytechnic University to be used for courses involving collaborative projects in the Bachelors of Arts in Marketing and Public Relations program. To enhance students' effectiveness in using this collaborative technology, the current study investigated the relationship between Web 2.0 tools and education involving collaborative projects. In greater detail, this study aims at developing a design framework for collaborative learning using Google Applications Technology.

3 Theoretical Perspective

There have been a large number of researches that focus on computer-supported collaborative work. Previous researches on collaborative technologies focus on the technical aspects of the computer-mediated environments. Research that focuses on the context of learners in the environment has been limited. It has been recognized that a design framework can be benefited from an understanding of the context in which the users work [9]. In a computer-supported learning environment, a study of the context in which the technology is implemented helps in understanding the domain in terms of relations among individuals, artifacts, and social groups. Internet-based collaborative technologies are implemented with complicated interactions among participants and learning materials. It is therefore important to understand knowledge building involved in collaborative tasks.

Knowledge building refers to “the practices of meaning-making in the context of joint activity” [11]. Activity theory provides a theoretic lens to understand knowledge building and activity-oriented design method (AODM) [7] offers a comprehensive method for capturing the relationships that are derived from individual and group perspectives. Activity theory originates from the socio-cultural theories of Vygotsky and is articulated by Engeström [4][5]. It provides an analytic lens to understand complex learning environments, especially for those that are mediated by tools. According to Vygotsky [12], humans do not interact directly with their environment. They do so by interactions that are mediated by signs and tools. According to Vygotsky’s theory of mediated action, social activities articulate the developmental transformation of internalized cognitive structures. Engeström also established a simple structural model of the concept of activity and cultural mediated relationships. According to Engeström [3], “activity is the smallest and most simple essential unit that still preserves the essential integral quality behind any human activity.”

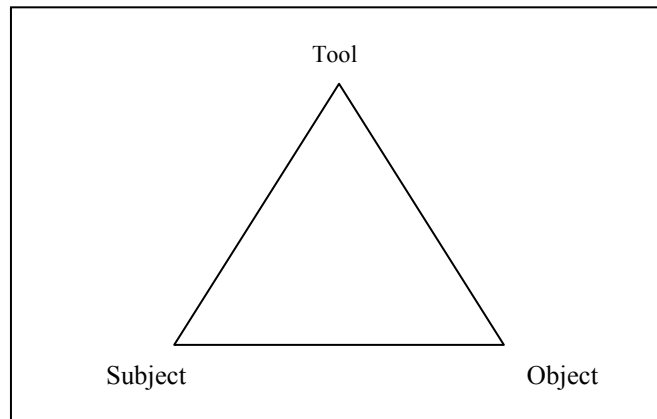


Fig. 1. The Basic Mediational Model

A common reformulation of Vygotsky's mediational triangle is depicted in Fig 1. In the basic mediational model, an activity system consists of a subject and the object of the activity, and the community in which the subject is constituted. The relationship between the subject and object is mediated by a tool or artifact. Activity-oriented design method provides a useful framework for the design of collaborative learning environments because it posits that learning takes place as learners engage in activities. The goal of activity systems is to transform the object (objective) into an outcome through a mediated tool or artifact.

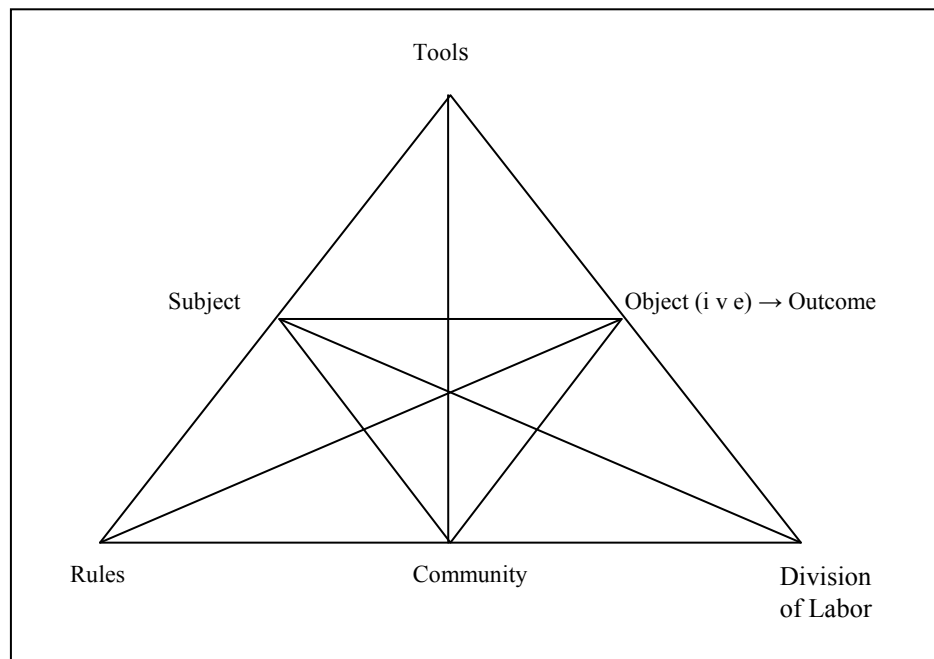


Fig. 2. The Activity System

The activity system established by Engeström is shown in Fig 2. It contains the components that are organized to accomplish the activities of the activities subsystems, including subjects, objects and their associated outcomes, tools, rules, community and division of labor. The subject represents the individual or groups of members engaged in the activities. The object represents the motive or problem space and the goal of the activity system to transform the object (objective) into a useful outcome. The tools represent the artifacts used in the human activity, including physical objects and other resources. Rules represent the explicit regulations, policies, norms, expectations and conventions that constrain the means by which the activity is carried out. The community consists of individuals and groups of members who engage their efforts on the object. Division of labor refers to the construction of roles

and responsibilities among the members of the community. The activity system shown in figure 2 is an expanded form of the basic mediational triangle developed by Vygotsky. In the activity system, the relationship between subject and object is mainly mediated by tools; the relationship between subject and community is mainly mediated by rules; and the relationship between community and object is mainly mediated by division of labor.

4 The Google Applications Project Environment

To avoid overgeneralizations, this study concentrates on the development of design frameworks for collaborative learning environments in a given course context, where the consequences of design changes can be analyzed in-depth by the researcher. The subject “advanced marketing research (AMR)” taught in blended mode at the Hong Kong Polytechnic University was being selected for implementation and evaluation. In this subject, students worked for a marketing research project for selected companies in groups with five to six students. The evaluation was wholly based on continuous assessment, which consisted of five project-based assignments. The assessment components included participation in Web-based activities, sharing of information and collaborative documents in project work.

The type of collaborative learning undertaken in this project is commonly known as computer-mediated collaborative work. The Web-based platform for supporting collaborative learning integrates the five components of Google Applications. They are implemented using Web 2.0 facilities, including Google Docs, Google Forms, Google Sites, Google Group Forums and Google Drive Share Space. These facilities promote interactions and collaborative learning between the participants. Students not only learn by participation, they also see how other students work in the Web 2.0 environment. The Web 2.0 environment promotes a “meaningful discourse” to the learning activities, where knowledge is constructed through the collaboration facilities provided by Google Applications.

The Google Applications collaborative learning platform is developed using an Activity-Oriented Design Method (AODM) [7]. Based on AODM, this research focuses on developing a comprehensive Web 2.0 environment that facilitates collaborative learning among the course participants. In this approach, individual and group perspectives are involved in the development and deployment of collaborative learning environments. The research illustrates the challenges involved in designing e-learning environments based on activity theory. Activity-oriented design method posits learning as located in contexts and relationships rather than merely in the minds of individuals, and that learning drives from participation in joint activities and social practices that are mediated by artifacts and collaborative tools. This research integrates Web 2.0 research and collaborative learning. As shown in Fig. 3, the collaborative environment integrates Google Sites, Discussion Forums, Google Docs, Google Forms, Google Sites and Google Drive shared file space for group-based projects.



Fig. 3. A Student Project Web Site Implemented with Google Applications Technology.

5 An Activity-Oriented Design Framework for Collaborative Learning

5.1 Learning Tasks and Activities

In the advanced marketing research class, student groups with five to six members were required to work on a "real-world" case study, decide on a research topic and conduct an empirical research for a selected company. For example, a student group may work on a research topic "Predicting Online Purchase Intentions for Taobao.com", and work as a group to conduct research with 100 consumers who have made purchase with taobao.com [8]. They were required to collaborate with their team members to conduct a real-world research project, produce a market research report and provide presentation to demonstrate their understandings of the research issues involved in the marketing process.

The subject was assessed by five assignments, with the associated tasks, objects, communities, rules, division of labor and tools listed in table 1. A detailed form of the activity system from the perspective of the class is shown in Fig. 4. In the activity system, the tools are elaborated to include artifacts, practices and technological components required for designing a Web 2.0 environment to support project-based collaboration activities.

Table 1. The Group Project and Five Assignments.

	Grp Prj	Assgn1	Assgn2	Assign3	Assgn4	Assgn5
Task	Market Research Project	Project Proposal	Literature Review	Questionnaire Design (Survey)	Data Analysis Report	Final Project Report
Object	Develop conceptual and practical knowledge of marketing research methods	Focus on a topic to make a research proposal	Focus on market research issues and research framework from literature	Develop a questionnaire based on a research framework & conduct survey	Understand advanced data analysis techniques for quantitative research	Practice professional report writing, skills, addressing reliability and validity issues
Comm-unity	Among student peers/research participants/ lecturer	Project group/ lecturer	Individual members in a project group	Project Group, 100 research participants and online communities	Project group	Project group
Rules	Empirical research based on a research model	The topic should relate to research issues	Literatures need to relate to a consolidated research model	Need to relate to market issues & constructs developed in the research framework	Data analysis need to address the research questions	Project leader/members communicate with lecturer to ensure that the research is well-focused.
Division of Labor	Project groups members are required to distribute responsibilities and learn from peers	Required among project leader/ members	Required among project leader/ members	Required among project leader/ members	Required among project leader/ members	Required among project leader/ members
Tools	Quizzes, Group Project Presentations Group Project Web site, Wiki, email and RSS feeds, mini-blogs, Google Docs, forums, and shared document space, Teaching Web site	Project Web site mini-blogs SPSS	Project Web site, mini-blog, research proposal, Google Scholar, Google connect document sharing, Google PPT for presentation	Frameworks from literature, Google forms, Online survey tools from Google	Project Web site. Mini-blogs, SPSS, Google Doc	Project Web Site, mini-blogs Google Drive, Google Doc

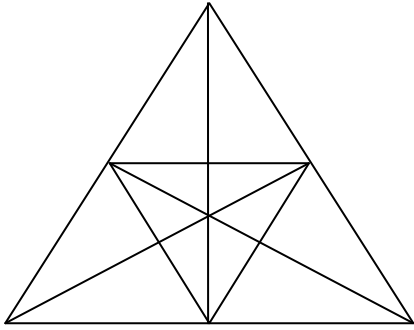
Artifacts, Tools & Practices				
Social <ul style="list-style-type: none"> - Collaborations with small group project work - Individual literature review consolidated among group members to derive a research framework 	Assignments <ul style="list-style-type: none"> - Quizzes - Group-based marketing research project - 5 assignments - Weekly discussions in forums - Rubrics - Group project presentations 	Cognitive <ul style="list-style-type: none"> - Critical review of literature - Data Collection Instruments - Comparing project outcomes with other teams - Peer critiquing, and collective aggregation 	Technological <ul style="list-style-type: none"> - Group project Web site - Wikis - Emails - Google Docs for collaborative writing, and developing online surveys - RSS feeds 	<ul style="list-style-type: none"> - Mini-blogs - Forums - Shared document space - Google sites sharing between different groups to share project practices - Teaching Web site for downloading lecture notes
Subject Class of Advance Marketing Research Students				Object Develop knowledge of marketing research methods → Outcome <ul style="list-style-type: none"> - Students become professional market researchers - Integrate knowledge developed in the course to become researchers
Values, Rules & Conventions <ul style="list-style-type: none"> - Students define and work on the empirical research based on a research model from literature - Students learn among their peer groups and from other group members from Web-based collaborative facilities - Evidence of collaboration and participation in the Google Web site and activities logs, which accounts for 15% of course assessments 	Community <ul style="list-style-type: none"> - Student peers - Research participants - Lecturer and instructors 		Division of Labor <ul style="list-style-type: none"> - Project groups members are required to distribute responsibilities and learn from peers - Students complete 5 group-based assignments - Groups complete final report together - Leader is responsible for the focus of the research and the lecturer guides the direction of research 	

Fig. 4. The Teaching and Learning Activity System from the Perspective of Students

5.2 Collaborative Learning and Investigation of Contradictions

With the objective of providing a collaborative project environment for implementing project-based activities, the activity system can also be analyzed with reference to the sub-activity of the activity system. There are three basic components of a sub-activity, which are: the identified object of the activity system, a particular actor (e.g., subject, Community), and a mediator (e.g., tools rules, division of labor). To provide an illustration of the process of analyzing the sub-activity notation using one sub-activity, consider the following research question generated from the analysis of the sub-activity:

“How does the distributed responsibility for the group assignments (Division of Labor) affect student’s (Subject) development of practical and conceptual knowledge of marketing research methods and practices (Object)?”

The above activity-oriented question highlights the important contradictions that might exist within activity system. The contradiction that can be derive from this sub-activity is that by having the division of labor for a group-oriented task, some students become free-riders and do not participate (as shown from the analysis in Fig. 5). Using AODM, it is possible to identify the possible contradictions that exist within the activity system by analyzing all the sub-activity triangles. The details of other contradictions that exist within the teaching and learning activity system are reported in another publication [1]. It also highlights the solutions for e-learning designer to deal with the problems that arise from these contradictions.

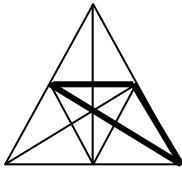
<p>Subject-Div. Labor-Object</p> 	<p>Question: How does the distributed responsibility for assignments affect students’ development of practical and conceptual knowledge in marketing research and practices?</p>	<p>Possible area of contradiction: Some group members act as free riders and do not participate actively in the group project assignment.</p>
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Fig. 5. An Example of Contradiction Generated from the Sub-Activity Question

6 Conclusion and Evaluation

In this research, activity theory was used as a design framework for collaborative learning in a Web 2.0 environment using Google Applications technology. An activity

system was used to analyze the relationship between the basic components, which include: the identified object of the activity system, a particular actor (e.g., subject, Community), and a mediator (e.g., tools rules, division of labor). These components are used in the activity-oriented design method for collaborative learning. By employing an activity-oriented design method, a collaborative platform was developed to facilitate social learning activities that are mediated by artifacts and collaborative tools using the Google Applications environment. This research distinguishes from other technical-oriented studies because a social learning approach was used in the research framework. The socio-cultural approach adopted in this research facilitates understanding of the relationships between the components in a collaborative learning environment from a community-building perspective. Future direction of research could focus on the resolution aspects generated from the contradictions between different communities and sub-activities.

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